SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF, DELAMINATION METHOD, AND TRANSFERRING METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a delamination method of a functional thin film, particularly to a delamination method of a film or a layer each of which is provided with various elements. In addition, the present invention relates to a transferring method for pasting a separated film to a film substrate, and further relates to a semiconductor device comprising a thin film transistor (hereinafter referred to as a TFT), which is formed in accordance with the transferring method, and to a manufacturing method thereof.

2. Description of the Related Art

Recently, a technique for forming a TFT by using a semiconductor thin film (with a thickness of about several nanometers to several hundred nanometers) formed over a substrate provided with an insulating surface is attracting attention. A TFT is widely applied to an electronic device such as an IC or an electro-optic device, and is developed especially as a switching element or a driver circuit of a display device.

Such display devices can be mass-produced by performing dicing for obtaining multiple panels. Glass substrates and quartz substrates are mostly used; however, they have disadvantages of fragility and heaviness to be enlarged. Therefore, forming a TFT element on a flexible substrate typified by a flexible plastic film is being tested.

However, when a sophisticated polysilicon film is used for an active layer of a TFT; a process at a high temperature at several hundred degrees centigrade is necessary in a manufacturing process, so that the polysilicon film can not be formed directly on a plastic film.

Therefore, a method of separating a delamination layer from the substrate by using a separation layer in between is proposed. For example, a separation layer comprising such as amorphous silicon, a semiconductor, nitride ceramics, or an organic polymer is provided and exposed to a laser beam through the substrate; the substrate is separated by a delamination or the like in the separation layer (Reference 1: Japanese Patent Laid-open Publication No. 10-125929). In addition, a reference describes an example of completing a liquid crystal display device by pasting a delamination layer (referred to as a layer to be transferred) to a plastic film (Reference 2: Japanese Patent Laid-open Publication No. 10-125930). Techniques of respective companies are introduced in the articles on flexible displays (Reference 3: Nikkei Microdevices, Nikkei Business Publications, pp. 71-72, Jul. 1, 2002).

However, in the method described in the above publications, it is required to use a substrate which is highly transparent to light. Further, a rather high-energy laser beam is necessary for imparting sufficient energy to release hydrogen included in amorphous silicon through a substrate. That causes a problem of damage to a delamination layer. Further, the above publication describes a structure in which a light-resistant layer or a reflective layer is provided to prevent the damage to the delamination layer; however, in that case, it is difficult to fabricate a transmissive liquid crystal display device or a light emitting device which emits

light downward. Still further, with the above method, it is difficult to separate a delamination layer having a large area.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above problems and it is an object of the present invention to provide a technique for performing separation between a substrate and a delamination layer by a physical means or a mechanical means in a state where a metal film formed over a substrate, and a delamination layer comprising an oxide film including the aforementioned metal and a film comprising silicon, which is formed over the metal film, are provided. Specifically, a TFT obtained by forming an oxide layer including the aforementioned metal over a metal film; crystallizing the aforementioned oxide layer by heat treatment; and performing delamination in a layer of the oxide layer or at the interfaces of both surfaces of the aforementioned oxide layer is formed.

A TFT formed according to the present invention can be applied to any light emitting device of top emission type or bottom emission type; or to any liquid crystal display device of transmissive type, reflective type, or semi-transmissive type; or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A to **1**E show a delamination process according to the present invention.

FIG. **2** shows an experimental sample in the present invention.

FIGS. **3**A and **3**B show a TEM picture and the frame format of experimental sample A in the present invention.

FIGS. **4**A and **4**B show a TEM picture and the frame format of experimental sample B in the present invention.

FIGS. **5**A and **5**B show a TEM picture and the frame format of experimental sample C in the present invention.

FIGS. **6**A and **6**B show a TEM picture and the frame format of experimental sample D in the present invention.

FIGS. **7**A and **7**B show a TEM picture and the frame format of experimental sample E in the present invention.

FIGS. **8**A and **8**B are a figure showing EDX spectrum and a quantitative result of experimental sample A in the present invention.

FIGS. **9**A and **9**B are a figure showing EDX spectrum and a quantitative result of experimental sample B in the present invention.

FIGS. **10**A and **10**B are a figure showing EDX spectrum and a quantitative result of experimental sample C in the present invention.

FIGS. **11**A to **11**D show experimental samples in the present invention.

FIGS. **12**A and **12**B show a TEM picture and the frame format of experimental sample 1 in the present invention.

FIGS. **13**A and **13**B show a TEM picture and the frame format of experimental sample 2 in the present invention.

FIGS. **14**A and **14**B show a TEM picture and the frame format of experimental sample 3 in the present invention.

FIGS. **15**A and **15**B show a TEM picture and the frame format of experimental sample 4 in the present invention.

FIGS. **16**A to **16**C show XPS measurements of experimental samples A to C in the present invention.

FIGS. **17**A to **17**F are figures in which XPS measurements shown in FIGS. **16**A to **16**C are standardized.

FIGS. **18**A to **18**C show XPS measurements of experimental samples A to C in the present invention.